National Qualifications 2013/14

PHYSICS

National 5

Practice paper.

Testing Units

H256 75 Electricity and Energy

H25A 75 Waves and Radiation

H258 75 Dynamics and Space

Time: 2 hours

Read Carefully

Reference may be made to the Physics Data Booklet.

1. All questions should be attempted.

Section 1 (questions 1 to 20)

2. Check that the answer sheet is for Physics Higher (Section 1).
3. For this section of the examination you must use an **HB pencil** and, where necessary, an eraser.
4. **Print** your name and class in the boxes provided.
5 There is **only one correct** answer to each question.
6. Any rough working should be done on the rough working sheet, **not on** your answer sheet.
7. At the end of the exam, put the answer sheet for Section 1 on top of your other answers.
8. Instructions as to how to record your answers to questions 1-20 are given on page three.

Section 2 (questions 1 to 9)

9. Answer the questions numbered 1 to 9 on the question paper.
10. All answers must be written clearly and legibly in ink.
11. Care should be taken to give an appropriate number of significant figures in the final answers to calculations.
12. Where additional paper, eg. square ruled paper, is used, write your name on it and place it with your answer sheets.

DATA SHEET

Speed of light in materials

Material	*Speed* in ms^{-1}
Air	$3{\cdot}0 \times 10^8$
Carbon dioxide	$3{\cdot}0 \times 10^8$
Diamond	$1{\cdot}2 \times 10^8$
Glass	$2{\cdot}0 \times 10^8$
Glycerol	$2{\cdot}1 \times 10^8$
Water	$2{\cdot}3 \times 10^8$

Gravitational field strength

	Gravitational field strength on the surface in $N kg^{-1}$
Earth	9·8
Jupiter	23
Mars	3·7
Mercury	3·7
Moon	1·6
Neptune	11
Saturn	9·0
Sun	270
Uranus	8·7
Venus	8·9

Specific latent heat of fusion of materials

Material	*Specific latent heat of fusion* in $J kg^{-1}$
Alcohol	$0{\cdot}99 \times 10^5$
Aluminium	$3{\cdot}95 \times 10^5$
Carbon Dioxide	$1{\cdot}80 \times 10^5$
Copper	$2{\cdot}05 \times 10^5$
Iron	$2{\cdot}67 \times 10^5$
Lead	$0{\cdot}25 \times 10^5$
water	$3{\cdot}34 \times 10^5$

Specific latent heat of vaporisation of materials

Material	*Specific latent heat of vaporisation* in $J kg^{-1}$
Alcohol	$11{\cdot}2 \times 10^5$
Carbon Dioxide	$3{\cdot}77 \times 10^5$
Glycerol	$8{\cdot}30 \times 10^5$
Turpentine	$2{\cdot}90 \times 10^5$
Water	$22{\cdot}6 \times 10^5$

Speed of sound in materials

Material	*Speed in* ms^{-1}
Aluminium	5200
Air	340
Bone	4100
Carbon Dioxide	270
Glycerol	1900
Muscle	1600
Steel	5200
Tissue	1500
Water	1500

Specific heat capacity of materials

Material	*Specific heat capacity* in $J kg^{-1} {}^oC$
Alcohol	2350
Aluminium	902
Copper	386
Glass	500
Ice	2100
Iron	480
Lead	128
Oil	2130
Water	4180

Melting and boiling points of materials

Material	*Melting point* in ^oC	*Boiling point* in ^oC
Alcohol	-98	65
Aluminium	660	2470
Copper	1077	2567
Glycerol	18	290
Lead	328	1737
Iron	1537	2737

Radiation weighting factor

Type of radiation	*Radiation weighting factor*
alpha	20
beta	1
fast neutrons	10
gamma	1
slow neutrons	3

SECTION 1

For questions 1 to 20 in this section of the paper the answer to each question is either A, B, C, D or E. Decide what your answer is, then, using your pencil, put a horizontal line in the space provided ï see the example below.

EXAMPLE

The energy unit measured by the electricity meter in your home is the

A kilowatt-hour

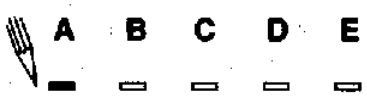
B ampere

C watt

D coulomb

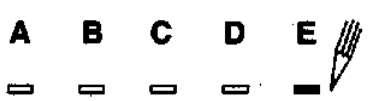
E volt.

The correct answer is A ï kilowatt-hour. The answer A has been clearly marked in pencil with a horizontal line (see below).



Changing an answer

If you decide to change your answer, carefully erase your first answer and, using your pencil, fill in the answer you want. The answer below has been changed to E.



[Turn over

SECTION 1

1. 1 ampere is equivalent to

A 1 joule per second

B 1 coulomb per second

C 1 volt per second

D 1 volt per coulomb

E 1 coulomb per joule

2. A heating element is connected to a 12 V supply. A current of 2.5 A is drawn for 2 minutes. The energy used by the heating element is

A 0.25 J

B 30 J

C 60 J

D 1440 J

E 3600 J

3. A student makes the following statements about specific heat capacity.

I specific heat capacity is the energy required to raise the temperature of 1 kg of a substance by $1^{o}C$

II specific heat capacity depends on the mass of the substance.

III the unit for specific heat capacity is the $J^{-1o}C$

Which of the statements is/ are correct?

A I only

B III only

C I and II only

D II and III

E I, II and III

4. Energy is measured in

A amperes

B coulombs

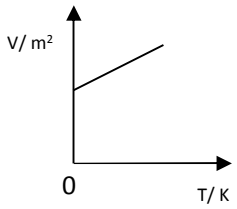
C joules

D metres per second

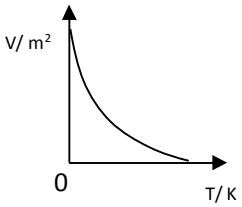
E watts

5. Which of the following graphs shows the relationship between volume and temperature of a fixed mass of gas at a constant pressure?

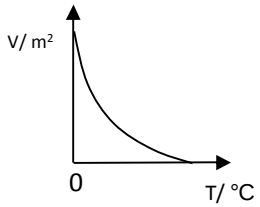
A



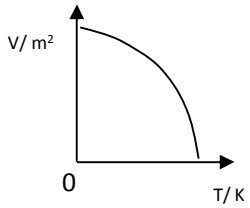
B



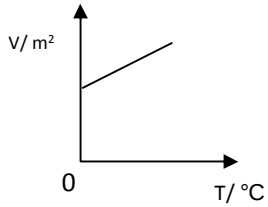
C



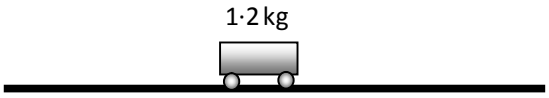
D



E



6. A trolley of mass 1·2 kg travels along a level track at 2 ms^{-1}.



The kinetic energy of the trolley is

A 1·20 J

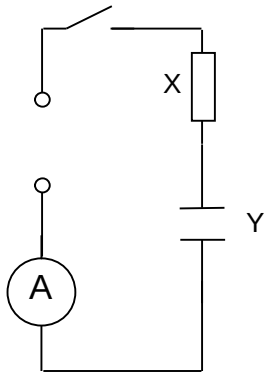
B 1·44 J

C 2·40 J

D 2·88 J

E 4·80 J

7. A student sets up the circuit shown. Which row in the table identifies components X and Y?



	Component X	*Component Y*
A	ammeter	capacitor
B	resistor	switch
C	capacitor	resistor
D	resistor	capacitor
E	resistor	cell

8. A student makes the following statements about waves.

I Waves transfer energy.

II When waves reflect off of a surface the angle of incidence is greater than the angle of reflection.

III Waves of long wavelengths diffract more than waves of short wavelength.

Which of the statements is/ are correct?

A I only

B III only

C I and II only

D I and III

E I, II and III

9. Which row shows the waves of the electromagnetic spectrum in order of increasing wavelength?

A blue, green, red

B greed, red, blue

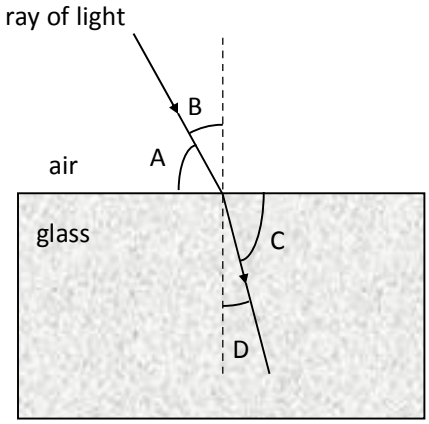
C blue, red, green

D red, green, blue

E green, blue, red

10. The diagram below shows light travelling from air into a glass block.

Which row in the table identifies the angles of incidence and refraction?



	Angle of incidence	*Angle of refraction*
A	A	C
B	B	C
C	A	D
D	B	D
E	D	A

11. Gamma radiation can be absorbed by

A a few centimetres of air

B a few millimetres of paper

C a few centimetres of paper

D a few millimetres of aluminium

E several metres of concrete

12. A 0·75 kg sample of tissue is exposed to 15 mJ of radiation for 3 minutes.

The absorbed dose for this radiation is

A 0·01 Gy

B 0·02 Gy

C 0·06 Gy

D 3·6 Gy

E 20·0 Gy

13. A radioactive source is monitored; it is found that 12 000 nuclei decay every two minutes.

The activity of the radioactive source is

A 100 Bq

B 100 kBq

C 6000 Bq

D 24 kBq

E 1440 kBq

14. Which of the following are both vector quantities?

A displacement and velocity

B speed and acceleration

C time and force

D momentum and speed

E energy and power

15. A boy runs 3 km due North. He then runs 4 km East. The total journey takes 1 hour.

His velocity is

A 5 kmhr^{-1} (037)

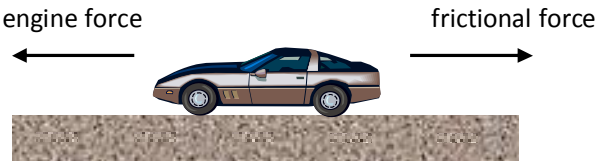
B 5 kmhr^{-1} (053)

C 5 kmhr^{-1} (307)

D 7 kmhr^{-1} (037)

E 7 kmhr^{-1} (053)

16. A car of mass 450 kg travels along a road with an acceleration of 1.5 ms^{-2}. The friction force acting on the car is 200 N.



The engine force is

A 200 N

B 300 N

C 475 N

D 675 N

E 875 N

17. One light year is

A $3.00 \times 10^{8}\ ms^{-1}$

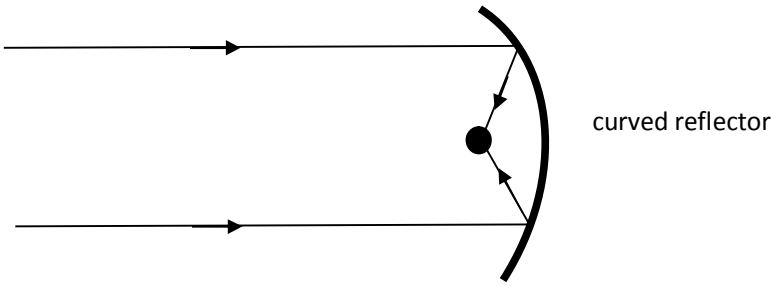
B $3.00 \times 10^{8}\ m$

C $1.41 \times 10^{11}\ ms^{-1}$

D $9.46 \times 10^{15}\ ms^{-1}$

E $9.46 \times 10^{15}\ m$

18. A signal is received using a curved reflector as shown.



Which of the following statements is/ are correct?

I The receiver is placed at the focus of the reflector.

II At the surface of the curved reflector, the angle of incidence of the signal is equal to the angle of reflection.

III Curved reflections are regularly used in the construction of communications satellites.

A I only

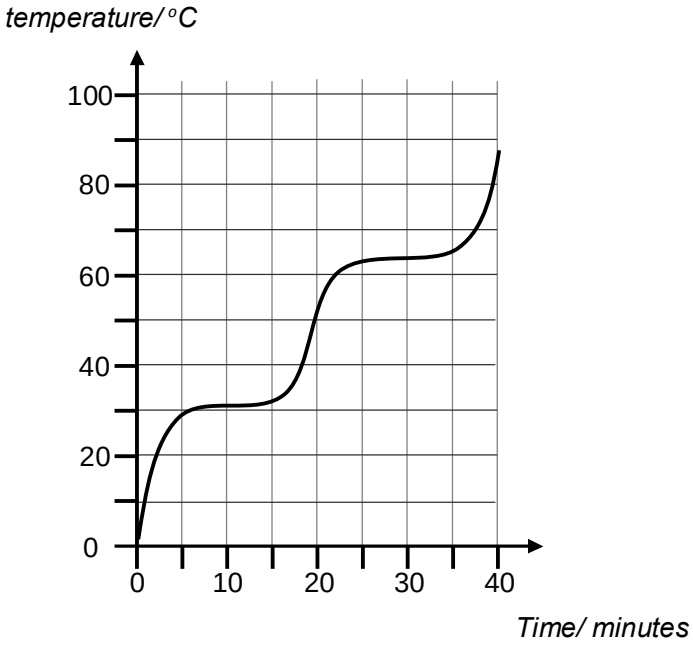
B III only

C I and II only

D II and III

E I, II and III

19. A mass of wax is heated over a 40 minute period. A graph of the temperatures recorded is shown below.



At what temperature did the wax melt?

A 20 °C

B 30 °C

C 50 °C

D 63 °C

E 85°C

20. The energy required to raise the temperature of 0Ã8 kg of water from 22 °C to 74°C is

A 4 180 J

B 173 888 J

C 267 200 J

D 334 000 J

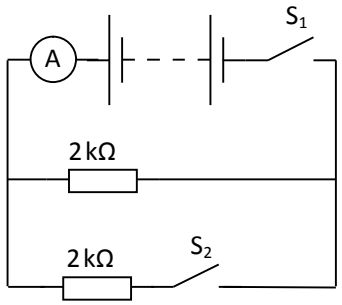
E 1 808 000 J

SECTION 2 – 90 marks

Attempt ALL questions

1. A student sets up the following circuit.

Switch S_1 is closed. The ammeter reading is 5.5 mA.



(a) Calculate the supply voltage. **3**

Space for working and answer

(b) Switch S_1 is closed for five minutes. Calculate the energy dissipated. **4**

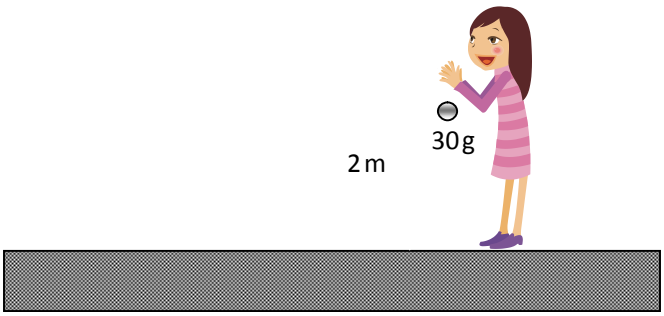
Space for working and answer

(c) Switch S_2 is now closed. Calculate the total resistance in the circuit. **3**

Space for working and answer

Total marks 10

2. A student investigating energy; drops a ball bearing of mass 30 g in the laboratory.



(a) Calculate the potential energy of the ball bearing when raised to a height of 2 m. **3**

Space for working and answer

(b) Find the velocity of the ball bearing on reaching the ground. **4**

Space for working and answer

On hitting the ground the ball bearing does not rebound, however its temperature rises.

(c) Using your knowledge of physics, explain why this happens. **2**

Total marks 9

3. A shop sells balloons for parties. A balloon sitting in the shop window is heated from 22 ^{o}C to 37 ^{o}C on a hot day.

The initial pressure of the gas inside the balloon was 2 x 10^5 Pa.

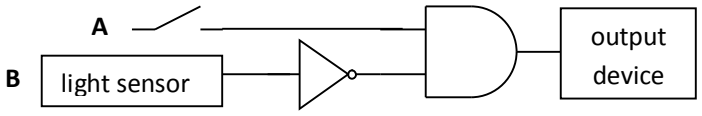
(a) State the temperature rise in Kelvin. **1**

(b) Calculate the pressure of the gas after the temperature rise. **3**

Space for working and answer

(c) Use the kinetic model to explain the rise in pressure. **3**

The owner of the shop wishes to install a system to alert him when it is dark and the door is opened.



switch closes when door is open output = 1

switch is open when door is open output = 0

when light, light sensor output = 1

when dark, light sensor output = 0

(d) Suggest a suitable output device for use in the circuit. **1**

(e) Complete the truth table. **3**

Input A	Input B	Output
0	0	
0	1	
1	0	
1	1	

Total marks 11

4. Sound waves are produced by a tuning fork. The sound waves have a frequency of 262 Hz and travel at 340 ms^{-1}.

(a) How far do they travel in 6 s? **3**

Space for working and answer

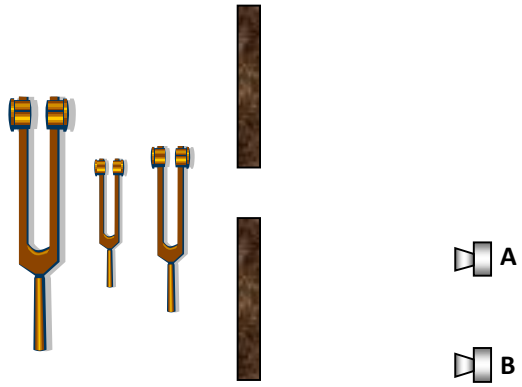
(b) Calculate the wavelength of the sound waves. **3**

Space for working and answer

(c) The waves have a period of 3Ā8 ms. Explain what is meant by this. **1**

Space for working and answer

The following experiment is set up. A variety of tuning forks are used in turn to produce sounds in front of a single slit barrier. Sound detectors are placed at points A and B.



(d) Using your knowledge of physics explain why a wider range of frequencies are likely to be detected at A. **3**

Total marks 10

5. The radiations of the electromagnetic spectrum are shown below.

Radio & TV	X	Infra red	Visible light	Ultra violet	X ray	Y

(a) Name radiations:

(i) X **1**

(ii) Y **1**

(b) Complete the table: **3**

Type of radiation	***Detector***
Radio	
	Blackened thermometer
Ultra violet	

(c) State the speed at which the radiations of the electromagnetic spectrum travel. **1**

(d) Calculate the time taken for ultra violet radiation to reach the Earth from the Sun which is $1{\cdot}14 \times 10^{11}$ m away. **3**

Space for working and answer

Total marks 9

6. A radiation worker is carrying out investigations. She must record the level of background radiation before she begins.

(a) State 2 sources of background radiation. **2**

(b) The worker exposes a tissue sample of mass 1·2 kg to 200 ε Gy of fast neutrons of weighting factor 20 over a 10 minute period.

Calculate the energy absorbed by the tissue sample. **3**

Space for working and answer

(c) Calculate the equivalent dose rate. **4**

Space for working and answer

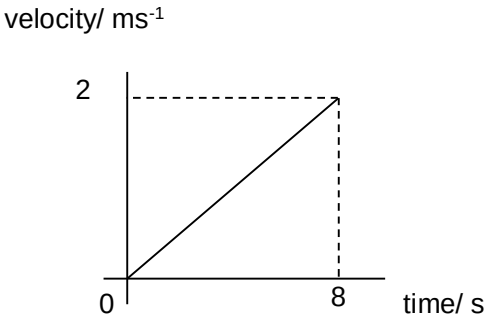
In the course of her work, the radiation worker is also exposed to radiation.

(d) Describe a method used to monitor the amount of radiation she is exposed to. **2**

Space for working and answer

Total marks 11

7. An elevator of mass 400kg is travelling upwards. A velocity time graph of its motion is shown.



(a) Use the graph to find the vertical distance travelled by the lift. **3**

Space for working and answer

(b) Calculate the work done in raising the elevator. **4**

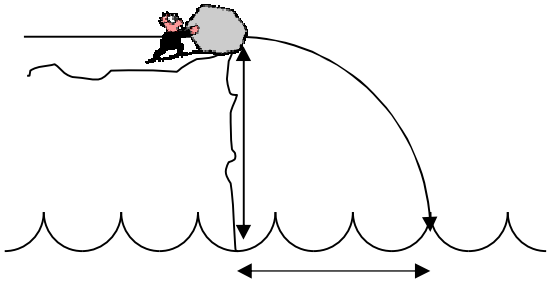
Space for working and answer

The elevator then descends at a constant velocity.

(c) Using one of Newtonôs laws, state and explain the forces acting on the elevator. **2**

Total marks 9

8. A rock is pushed off of the top of a cliff with a horizontal velocity $1{\cdot}5\,ms^{-1}$, it takes 6 s to land in the sea.



(a) Calculate the distance the rock reaches from the foot of the cliff. **3**

Space for working and answer

(b) Calculate the vertical velocity at 6 s. **3**

Space for working and answer

(c) On the same axis draw a graph with numerical values, showing how the vertical and horizontal velocities vary over the 6 s. **3**

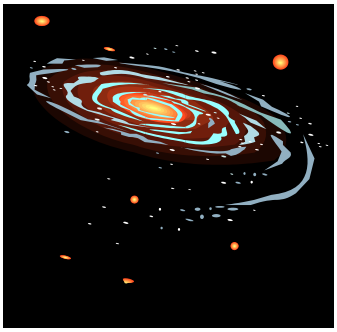
Space for working and answer

(d) Use the graph to calculate the height of the cliff. **3**

Space for working and answer

Total marks 12

9. Astrophysicists devote their time to the study of the universe. A theory describing the birth of the universe has been developed and is widely accepted.



(a) What is the name given to the theory of the origin of the universe? **1**

(b) List 2 pieces of evidence which support this theory. **2**

On re-entering the Earthûs atmosphere, a space shuttle experiences a huge amount of friction. To prevent excessive heating inside the space shuttle it is coated with tiles which have a large specific heat capacity.

(c) Explain how this protects the shuttle and crew. **3**

(d) If the total mass of protective tiles on the shuttle is 2500 kg and the temperature rise is 180 000 ^{o}C. The tiles absorb 2·8 x 10^{12}J of heat energy.

Calculate the value of specific heat capacity of the tiles. **3**

Space for working and answer

Total marks 9

PHYSICS

NATIONAL 5 PRELIM PAPER 2013 - 14

Section 1

ANSWER SHEET

Name _____ **Class** _____

Indicate your choice of answer with a single mark as in the following example. →

	A	B	C	D	E
1	▭	▬	▭	▭	▭

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

Section 1 ⧸

Section 2 ⧸

Total ⧸

Total ____ %

Grade ____

PHYSICS

NATIONAL 5 PRACTICE PAPER 2013 - 14

Section 1

ANSWERS

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

National 5 Practice Paper 2013-2014 — Section 2 Answers

Markers are advised to apply the marking guidelines as published by the S.Q.A. and sent to every school a few years ago. Answers given (particularly to 'describe' / 'explain' questions) are examples and are not exhaustive.

1. (a) $V = IR$ (*1*)

$= 5.5 \times 10^{-3} \times 2000$ (*1*)

$= \underline{11\ V}$ (*1*) 3

(b) $E = Pt$ (*1*)

$= I \times V \times t$ (*1*)

$= 5.5 \times 10^{-3} \times 11 \times 300$ (*1*)

$= \underline{18{\cdot}15\ J}$ (*1*) 4

(c) $1/R_T = 1/R_1 + 1/R_2$ (*1*)

$= 1/2000 + 1/2000$ (*1*)

$R_T = \underline{1000\ \Omega}$ (*1*) 3

(10)

2. (a) $E_p = mgh$ (*1*)

$= 0{\cdot}03 \times 9{\cdot}8 \times 2$ (*1*)

$= \underline{0{\cdot}59\ J}$ (*1*) 3

(b) $E_p = E_k$ (*1*)

$= \frac{1}{2}mv^2$ (*1*)

$0{\cdot}59 = 0{\cdot}5 \times 0{\cdot}03 \times v^2$ (*1*)

$v = \underline{6{\cdot}27\ ms^{-1}}$ (*1*) 4

(c) Energy is always conserved. (*1*)

Therefore the kinetic energy must be converted into internal heat energy of the ball bearing. (*1*) 2

(9)

3. (a) <u>15 K</u> (*1*) 1

(b) $P_1 / T_1 = P_2 / T_2$ (*1*)

$2 \times 10^5 / 295 = P_2 / 310$ (*1*)

$P_2 = \underline{2{\cdot}1 \times 10^5 \text{ Pa}}$ (*1*) 3

(c) (As the temperature rises, the average kinetic energy of the particles increases and so) the particles move with a greater velocity (*1*) and collide with the container walls more frequently,*(1)* producing an increase in the force. (*1*)

(Pressure = Force/ area therefore the pressure increases.) 3

(d) Buzzer/ LED/ lamp ï anything else deemed appropriate. (*1*) 1

(e)

Input A	Input B	Output
0	0	***0***
0	1	***0***
1	0	***1***
1	1	***0***

(*3*) for 4 correct, (*2*) for 3 correct, (*1*) for 2 correct and (*0*) for 1 3

(11)

4. (a) d = vt (*1*)

= 340 x 6 (*1*)

= <u>2040 m</u> (*1*) 3

(b) ~~a~~ = v/ f (*1*)

= 340 / 262 (*1*)

= <u>1·30 m</u> (*1*) 3

(c) It takes $3{\cdot}8 \times 10^{-3}$ s for one wave to be produced/ pass a point. (*1*) 1

(d) This is an example of an open ended question.

Demonstrates no understanding- 0 marks

Demonstrates limited understanding- 1 marks

Demonstrates reasonable understanding- 2 marks

Demonstrates good understanding- 3 marks

Refer to the marking instructions in the National 5 Specimen Paper for further guidance. 3

(10)

5. (a) (i) Microwave radiation (*1*) 1

(ii) Gamma radiation (*1*) 1

(b)

Type of radiation	***Detector***
Radio	***Aerial and electronic circuit***
Infra red	Blackened thermometer
Ultra violet	***Film/ skin***

3

(c) <u>3×10^{8} ms^{-1}</u> (*1*) 1

(d) $t = d/v$ (*1*)

$= 1{\cdot}14 \times 10^{11} / 3 \times 10^{8}$ (*1*)

$= \underline{380\ s}$ (*1*) 3

(9)

6. (a) Medical use, fallout from weapons testing, rocks and soil, cosmic rays and anything else deemed appropriate. (*1*) for each. 2

(b) $E = Dm$ (*1*)

$= 200 \times 10^{-6} \times 1{\cdot}2$ (*1*)

$= \underline{0{\cdot}24 \times 10^{-3}\ J}$ (*1*) 3

(c) $H = DW_R$ (*1*)

$= 200 \times 10^{-6} \times 10$ (*1*)

$= 2 \times 10^{-3}$ Sv (*1*)

$\check{G} = H/t = = 2 \times 10^{-3} / 10 = \underline{0{\cdot}2 \times 10^{-3}\ Sv\ per\ minute}$ (*1*) 4

(d) A film badge may be worn. (*1*)

When the film is developed the amount of fogging gives a measure of the amount of radiation exposure. (*1*) 2

(11)

7. (a) distance = area under graph = ½ x base x height (*1*)

$= 0{\cdot}5 \times 8 \times 2$ (*1*)

$= \underline{8\,m}$ (*1*) 3

(b) $E_w = Fd$ (*1*)

$= mg \times d$ (*1*)

$= 400 \times 9{\cdot}8 \times 8$ (*1*)

$= \underline{31360\,J}$ (*1*) 4

(c) As the elevator is moving at a constant velocity the forces acting on it must be balanced (Newton's 1st Law). (*1*)

Tension must be equal to weight (mg) (which is 3920 N.) (*1*) 2

(9)

8. (a) d = vt (*1*)

= 1·5 x 6 (*1*)

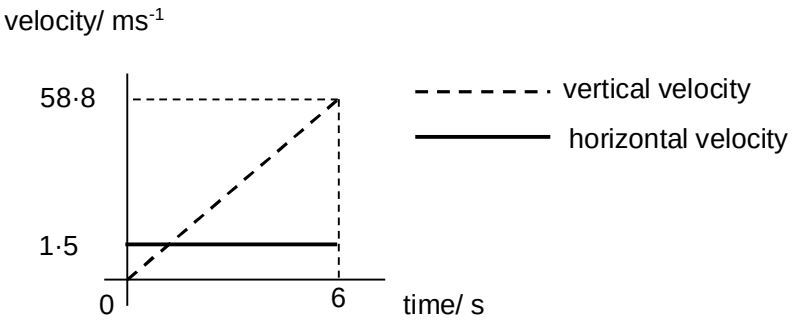
= 9 m (*1*) 3

(b) a = v ï u/ t (*1*)

v = 9·8 x 6 + 0 (*1*)

= 58·8 ms^{-1} (*1*) 3

(c)



(*1*) correctly labelled axis, (*1*) for correct horizontal, (*1*) for correct vertical 3

(d) height = area under graph = ½ x base x height (*1*)

= 0·5 x 6 x 58·8 (*1*)

= 176·4 m (*1*) 3

(12)

9. (a) The Big Bang Theory. (*1*) 1

(b) The presence of cosmic microwave radiation. (*1*)

Doppler effect, showing stars are moving away. (*1*)

Anything else deemed to be appropriate. 2

(c) (A large amount of friction is encountered during re-entry,) friction causes heating. (*1*)

(This heat energy is absorbed by the tiles and causes a rise in the temperature of the tiles. A large specific heat capacity value means) a large amount of energy must be absorbed to cause a small temperature increase in the tiles. (*1*)

Therefore the heat energy is stored within the tiles (and is kept away from the inside of the shuttle and its crew.) (*1*) 3

(d) $c = E_h / mq\rho T$ (*1*)

$= 2{\cdot}8 \times 10^{12} / (2500 \times 108000)$ (*1*)

$= \underline{10\ 370\ Jkg^{-1}\ {}^{o}C^{-1}}$ (*1*) 3

(9)

[Section 2 Total – 90]