

Name:..... Centre Number:.....

Candidate Number:..... Set Don(circle): WEB MJR



WINCHESTER COLLEGE

Physics Mock Paper 1

Block C WEB/MJR – Thursday 7th Jan 2016

Time allowed: 1 hour 30 minutes

DO NOT turn over until told that you may do so. Write your name, candidate number and centre number at the top of this page. Circle your set from the list provided above.

Write in dark blue or black pen. You may use a soft pencil for any diagrams, graphs or rough working. Do not use staples, paper clips, highlighters, glue or correction fluid.

You may use a calculator.

Assume $g = 9.81 \text{ N / kg}$ unless otherwise specified.

There are **forty** multiple choice questions.

For each question there are four possible answers; **A, B, C** and **D**.

Choose the **one** you consider correct and record your choice on the separate answer sheet.

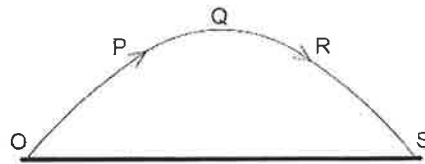
Read the instructions on the answer sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any working should be done in this booklet. You will not be marked on this.

There is a list of constants on the inside cover, followed by a list of formulae.

- 1) A projectile is launched at point O and follows the path OPQRS, as shown. Air resistance may be neglected.



Which statement is true for the projectile when it is at the highest point Q of its path?

- A The horizontal component of the projectile's acceleration is zero.
- B The horizontal component of the projectile's velocity is zero.
- C The kinetic energy of the projectile is zero.
- D The momentum of the projectile is zero.

(1)

- 2) Two equal masses travel towards each other on a frictionless air track at speeds of 60 cm s^{-1} and 30 cm s^{-1} . They stick together on impact.



What is the speed of the masses after impact?

- A 15 cm s^{-1}
- B 20 cm s^{-1}
- C 30 cm s^{-1}
- D 45 cm s^{-1}

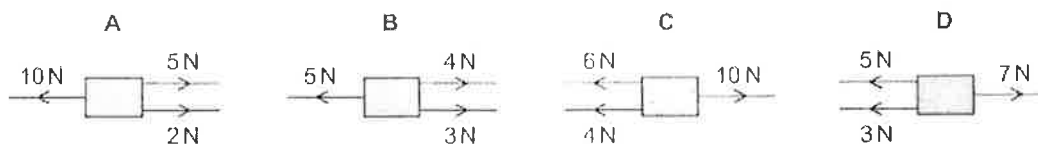
(1)

- 3) Which of the following is an expression for power?

- A energy x time
- B force x displacement
- C force x velocity
- D mass x velocity

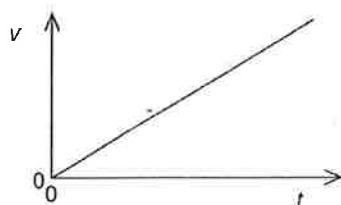
(1)

- 4) Which combination of forces produces a resultant force acting towards the right?



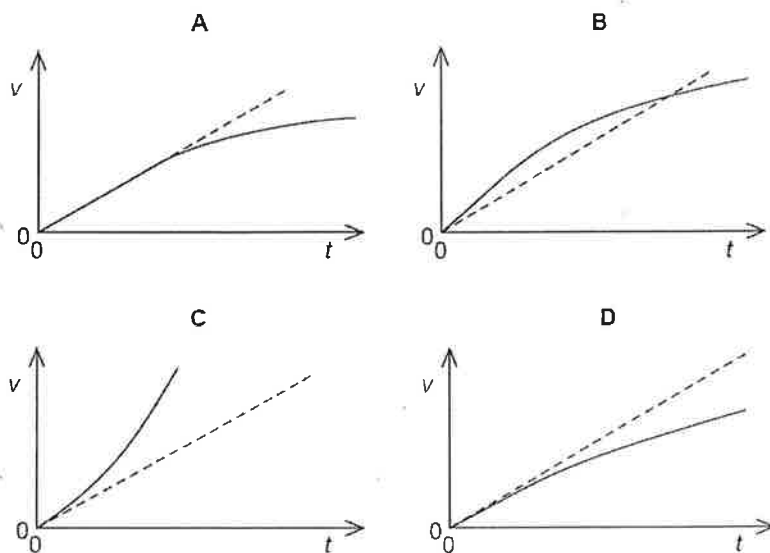
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- 5) A body falls from rest in a vacuum near the Earth's surface. The variation with time t of its speed v is shown below.



Which graph shows the variation with time t of the speed v of the same ball falling in air at the same place on Earth?

(1)

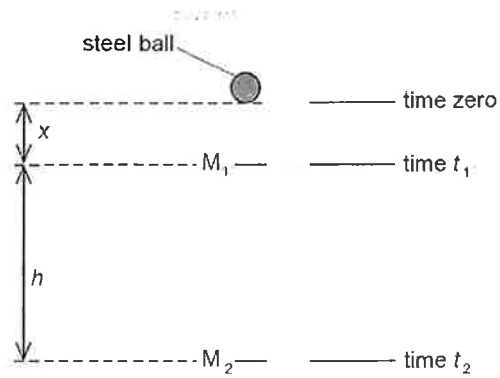


- 6) A lift has a mass of 12000 kg. It is ascending but slowing down at 2.0 m/s^2 . The tension in the cable must therefore be:

- A 118 kN B 94 kN C 142 kN D zero

(1)

- 7) Two markers M_1 and M_2 are set up a vertical distance h apart.



When a steel ball is released from rest from a point a distance x above M_1 , it is found that the ball takes time t_1 to reach M_1 and time t_2 to reach M_2 .

Which expression gives the acceleration of the ball?

- A $\frac{2h}{t_2^2}$ B $\frac{2h}{(t_2 + t_1)}$ C $\frac{2h}{(t_2 - t_1)^2}$ D $\frac{2h}{(t_2^2 - t_1^2)}$

8) The S.I. unit for the Young's modulus is:

- A N B Pa C Pa/m D Pa/m²

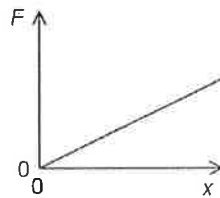
(1)

9) What is the ultimate tensile stress of a material?

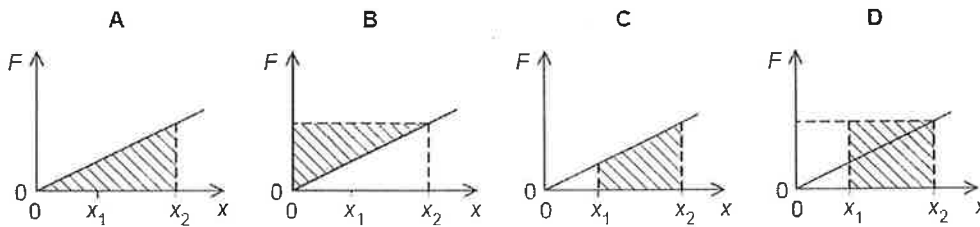
- A the stress at which the material becomes ductile
 B the stress at which the material breaks
 C the stress at which the material deforms plastically
 D the stress at which the material reaches its elastic limit

(1)

10) The variation of the extension x of a spring with applied force F is shown.

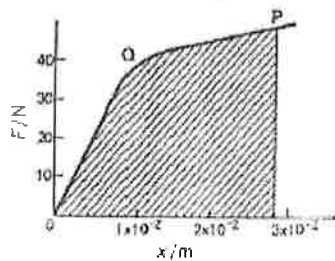


Which shaded area represents the work done when the extension is increased from x_1 to x_2 ?



(1)

- 11) The graph below shows the extension x of a length of copper wire produced by a force F , as the force is gradually increased. Which one of the following statements is **true**?

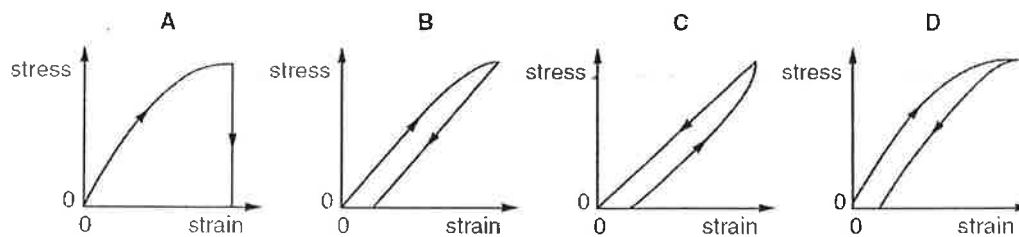


- A If, at P, the force is gradually reduced again to zero, the graph is retraced back to the origin.
- B If the experiment is repeated with twice this length of copper wire, then a force of 80N will be needed before the stage indicated by the point Q is reached.
- C If the experiment is repeated with a wire of double the diameter, then a force of 80N will be needed before the stage indicated by the point Q is reached.
- D At P, the work done stretching the wire is represented by the shaded area beneath the graph.

(1)

- 12) 19 A suspended copper wire is gradually loaded until it is stretched just beyond the elastic limit, and it is then gradually unloaded.

Which graph (with arrows indicating the sequence) best illustrates the variation of the tensile stress with longitudinal strain?



(1)

- 13) Nylon breaks when the stress within it reaches 1×10^9 Pa.

Which range includes the heaviest load that could be lifted by a nylon thread of diameter 1 mm?

- A 2 N to 20 N
- B 20 N to 200 N
- C 200 N to 2000 N
- D 2000 N to 20 000 N

(1)

- 14) The photoelectric effect, where electrons are ejected from a material by light, was explained by considering light to be quantised in photons. Which one of the following statements is *not* a reason for thinking that light is quantised?
- A The maximum kinetic energy of the electrons is independent of the light intensity.
 - B Electrons may be ejected as soon as the light is turned on.
 - C The maximum kinetic energy of the electrons depends on the frequency of the light.
 - D The rate of ejection of electrons is related to the intensity of the light.

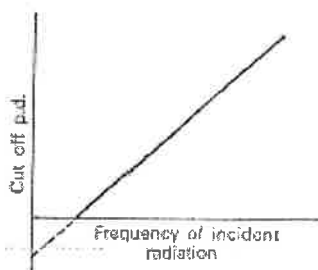
(1)

- 15) The maximum velocity v of electrons, each of mass m , emitted by a caesium photocell, is given by which of the following equations, where h = Planck's constant, f = frequency of incident electromagnetic radiation, and f_0 = the threshold frequency for caesium:

- A $\frac{1}{2}mv^2 = hf$
- B $\frac{1}{2}mv^2 = hf - hf_0$
- C $mv = hf$
- D $\frac{1}{2}mv^2 = mc\Delta\theta$

(1)

- 16) In an experiment on the photoelectric effect, the frequency of the incident radiation is varied and the 'stopping voltage' (the cut-off p.d. for which the current is zero) is measured. A graph as shown below is revealed. If the emitting electrode is now changed to one made of a different metal, which also gives photoelectrons, the graph changes. Which one of the following statements is *incorrect*?



- A The gradient changes
- B The x-intercept changes
- C the y-intercept changes
- D the y-intercept is $-\phi$, where ϕ is the work function of the electrode material

(1)

17) Which equation is used to define resistance?

- A power = (current)² × resistance
- B resistivity = resistance × area ÷ length
- C potential difference = current × resistance
- D energy = (current)² × resistance × time

(1)

18) The combined resistance R_T of two resistors of resistances R_1 and R_2 connected in parallel is given by the formula

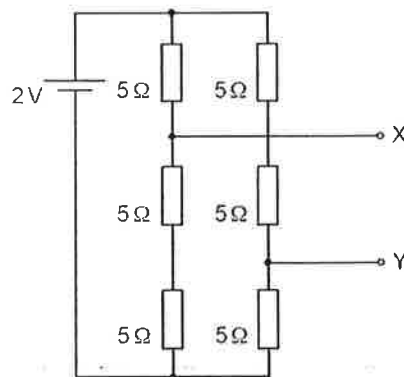
$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$$

Which statement is used in the derivation of this formula?

- A The currents through the two resistors are equal.
- B The potential difference across each resistor is the same.
- C The supply current is split between the two resistors in the same ratio as the ratio of their resistances.
- D The total power dissipated is the sum of the powers dissipated in the two resistors separately.

(1)

19) Six resistors, each of resistance 5Ω , are connected to a $2V$ cell of negligible internal resistance.



What is the potential difference between terminals X and Y?

- A $\frac{2}{3} V$
- B $\frac{8}{9} V$
- C $\frac{4}{3} V$
- D $2 V$

(1)

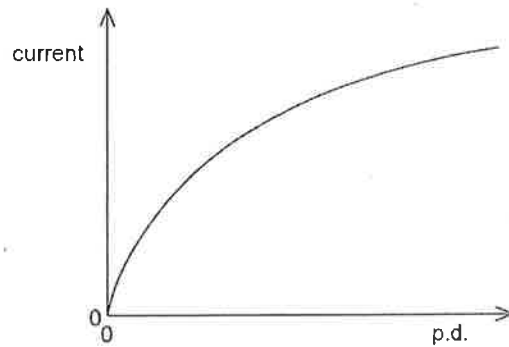
20) A battery has an emf of 12.8 volts and an internal resistance of 0.22Ω . When it is connected to a 3.2Ω resistor in series with a 4.4Ω resistor, then the power delivered to the 3.2Ω will be:

- A $9.1 W$
- B $51.2 W$
- C $8.6 W$
- D $21.0 W$

(1)

21)

The graph shows how the current through a lamp filament varies with the potential difference across it.



Which statement explains the shape of this graph?

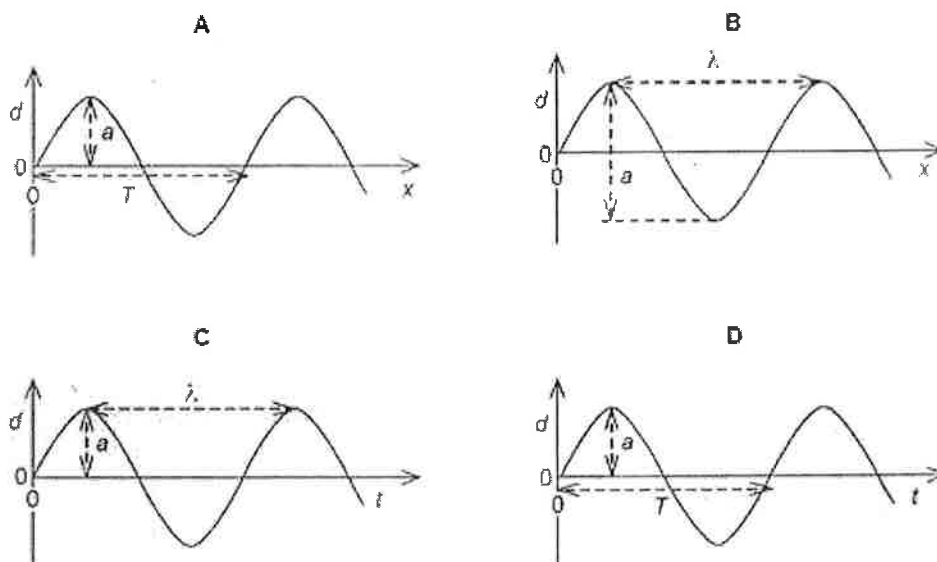
- A As the filament temperature rises, electrons can pass more easily through the filament.
- B It takes time for the filament to reach its working temperature.
- C The power output of the filament is proportional to the square of the current through it.
- D The resistance of the filament increases with a rise in temperature.

(1)

- 22) The four graphs represent a progressive wave on a stretched string. Graphs A and B show how the displacement d varies with distance x along the string at one instant. Graphs C and D show how the displacement d varies with time t at a particular value of x .

The labels on the graphs are intended to show the wavelength λ , the period T , and the amplitude a of the wave, but only one graph is correctly labelled.

Which graph is correctly labelled?



(1)

- 23)

Which value is a possible wavelength for radiation in the microwave region of the electromagnetic spectrum?

- A $3 \times 10^{-2} \text{ m}$ B $3 \times 10^{-6} \text{ m}$ C $3 \times 10^{-8} \text{ m}$ D $3 \times 10^{-10} \text{ m}$

(1)

- 24)

When the light from two lamps falls on a screen, no interference pattern can be obtained.

Why is this?

- A The lamps are not point sources.
 B The lamps emit light of different amplitudes.
 C The light from the lamps is not coherent.
 D The light from the lamps is white.

(1)

- 25)

Monochromatic light of wavelength 590 nm is incident normally on a diffraction grating. The angle between the two second-order diffracted beams is 43° .

What is the spacing of the lines on the grating?

- A $0.87 \mu\text{m}$ B $1.6 \mu\text{m}$ C $1.7 \mu\text{m}$ D $3.2 \mu\text{m}$

(1)

26) A laboratory on Earth is 2.83m high. A 3140 gram mass is to be raised from the floor to the ceiling. The difference in potential between the floor and the ceiling is:

- A 9.81 N/kg B 27.8 J/kg C 87.2 J/kg D 87.2 J

(1)

27) What is the S.I. unit of angular acceleration?

- A m/s B m/s^2 C rpm D $rad.s^{-2}$

(1)

28) A small wooden block of mass 22 grams is resting on a turntable a distance of 17 cm from the centre. The coefficient of friction between the block and the turntable is 0.82 (static) and 0.74 (dynamic). The turntable starts to spin faster and faster. The wooden block will slip off when the turntable rotates at:

- A 6.9 rad/s B 46 rad/s C 6.5 rad/s D 6.9 rpm

(1)

29) A disc made of aluminium has a moment of inertia of 16 kg.m^2 . A second disc made of aluminium has a mass and radius each twice that of the first disc. Its moment of inertia will be:

- A 16 kg.m^2 B 32 kg.m^2 C 64 kg.m^2 D 128 kg.m^2

(1)

30) Which of the following formulae is *incorrect*:

- A rotational kinetic energy = $\frac{1}{2} I \omega^2$
B $\omega = v r$
C $L = I \omega$
D $F = m r \omega^2$

(1)

31) A satellite moves at constant speed around a circular orbit. As it moves through a small angle $\Delta\theta$, which of the following statements is correct:

- A The work done is non-zero and the impulse is non-zero
B The work done is zero but the impulse is non-zero
C The work done is non-zero but the impulse is zero
D Both the work done and the impulse are zero.

- 32) A radioactive substance has a half-life of 2 weeks. At the beginning of an investigation the substance emits 3000 β -particles per minute.
How many β -particles will it emit per minute after 6 weeks?
A 0 B 375 C 500 D 1500
(1)
- 33) The half-life of krypton-92 is 3.00 seconds. If at time $t=0$ there are 5.12×10^{20} nuclei present, what would be the best estimate of how long it would take for there to be just 1000 krypton-92 nuclei left that have not decayed?
A 177 seconds B 5.2 years C 13.5 years D 13.5 seconds
(1)
- 34) Radium 226 decays by alpha emission (with a half-life of 1602 years) to Radon 222 which has a half-life of 3.8229 days. If we have an enclosed sample of radium, we find that the amount of radon present will quickly rise until the rate at which radon is decaying matches the rate at which radon is being created. An equilibrium has been reached.
If there is a mole of radium present, the equilibrium number of radon nuclei will be:
A 6×10^{23} B 1.4×10^{21} C 5.2×10^{23} D 3.9×10^{18}
(1)
- 35) 2.2 kg of water at 75 °C is added to 1.1 kg of water at 42 °C. The specific heat capacity of water is 4200 J/kg.K. Assuming no thermal energy is lost or gained, the final temperature of the mixture will eventually be:
A 58.5 °C B 117 °C C 64 °C D 58.5 K
(1)
- 36) Which of the following statements is correct?
A Standing waves must be transverse
B Electromagnetic radiation cannot form standing waves, since it travels so fast
C The distance between one node of a standing wave and the next is one wavelength
D Energy is stored in a standing wave
(1)
- 37) A spaceship travels past you at a speed of 0.98c. In the Earth frame of reference, a clock on board the spaceship will go slower than an Earth-based clock by a factor of:
A 5.02 B 50.1 C 7.07 D 2.0
(1)

- 38) Muons are created when cosmic ray protons impact with atomic nuclei in the upper atmosphere. Muons have a half-life of about 1.4 microseconds. In this time if they could travel at the speed of light they would travel a distance of just 420 metres. The speed of the muons is about $0.99998c$. The atmosphere is about 50 km high. Which one of the following statements is false:
- A muons can still reach the surface of the earth because in their frame of reference the distance is much shorter.
 - B the muons' 'clock' is time dilated according to observers on the earth.
 - C the muons' half-life is the same in the Earth's reference frame as in their own frame
 - D about 4.5 half-lives have elapsed by the time the muons reach the surface of Earth
- (1)

- 39) A body is moving with Simple Harmonic Motion with period 10 seconds. When it is at a distance of 20 cm from its center of motion, its acceleration is:
- A 9.7 cm/s^2 B 7.9 m/s^2 C 7.9 cm/s^2 D 97 cm/s^2

- 40) A shelf oscillates vertically with Simple Harmonic Motion, such that when its distance from the mean position is 1.0 cm, its velocity is 5.0 cm/s; when its distance from the mean position is 2.0 cm, its velocity is 3.0 cm/s. Its period is therefore:
- A 3.1 s B 2.7 s C 5.8 s D 11.2 s
- (1)